

WHAT IS CLAIMED IS:

1. (New) An enhanced volume phase grating, comprising:
 a substrate;
 a transparent cover; and
 5 a volume phase medium between the substrate and the transparent cover,
 wherein the volume phase medium has a thickness, T, a surface, and a bulk refractive index, the bulk refractive index is periodically modulated in a direction parallel to the surface of the volume phase medium, with a peak value of refractive index equal to $n + \Delta n$, where Δn is the peak modulation of said bulk refractive index and n is a refractive index, the periodic sequence of peak values of said bulk refractive index throughout the thickness of the volume phase medium provides a periodic structure of Bragg surfaces within said volume phase medium with a period, d, where the period, d, satisfies
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$$15 \quad d = \frac{\lambda}{n(\sin \alpha + \sin \beta)},$$

where λ is the nominal free-space wavelength for which said enhanced volume phase grating is designed,

$$20 \quad \Delta n = \frac{\lambda}{T} \left(\frac{2s-1}{2} \right) \sqrt{\left(\cos \alpha \right) \left(\cos \alpha - \frac{\lambda}{nd} \tan \left(\frac{\beta - \alpha}{2} \right) \right)},$$

s is a positive integer satisfying $s > p$, where p is another positive integer,
 θ_i is an arbitrary external angle of incidence, and
 β is an internal angle of diffraction that satisfies

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$$\beta = \text{either } a \cos \left(\frac{2p-1}{2s-1} \right) - \alpha \text{ or } 180 - a \cos \left(\frac{2p-1}{2s-1} \right) - \alpha,$$

where

$$\alpha = a \sin \left(\frac{\sin \theta_i}{n} \right),$$

whereby the S-polarization diffraction efficiency and the P-polarization diffraction efficiency of said enhanced volume phase grating, when illuminated by an incident beam of said nominal free-space wavelength, λ , at said external angle of incidence,

5 θ_i , are simultaneously maximized at a common value of the product $\Delta n T$, simultaneously minimizing insertion loss and PDL.

2. The enhanced volume phase grating of claim 1, wherein said volume phase medium is dichromated gelatin.